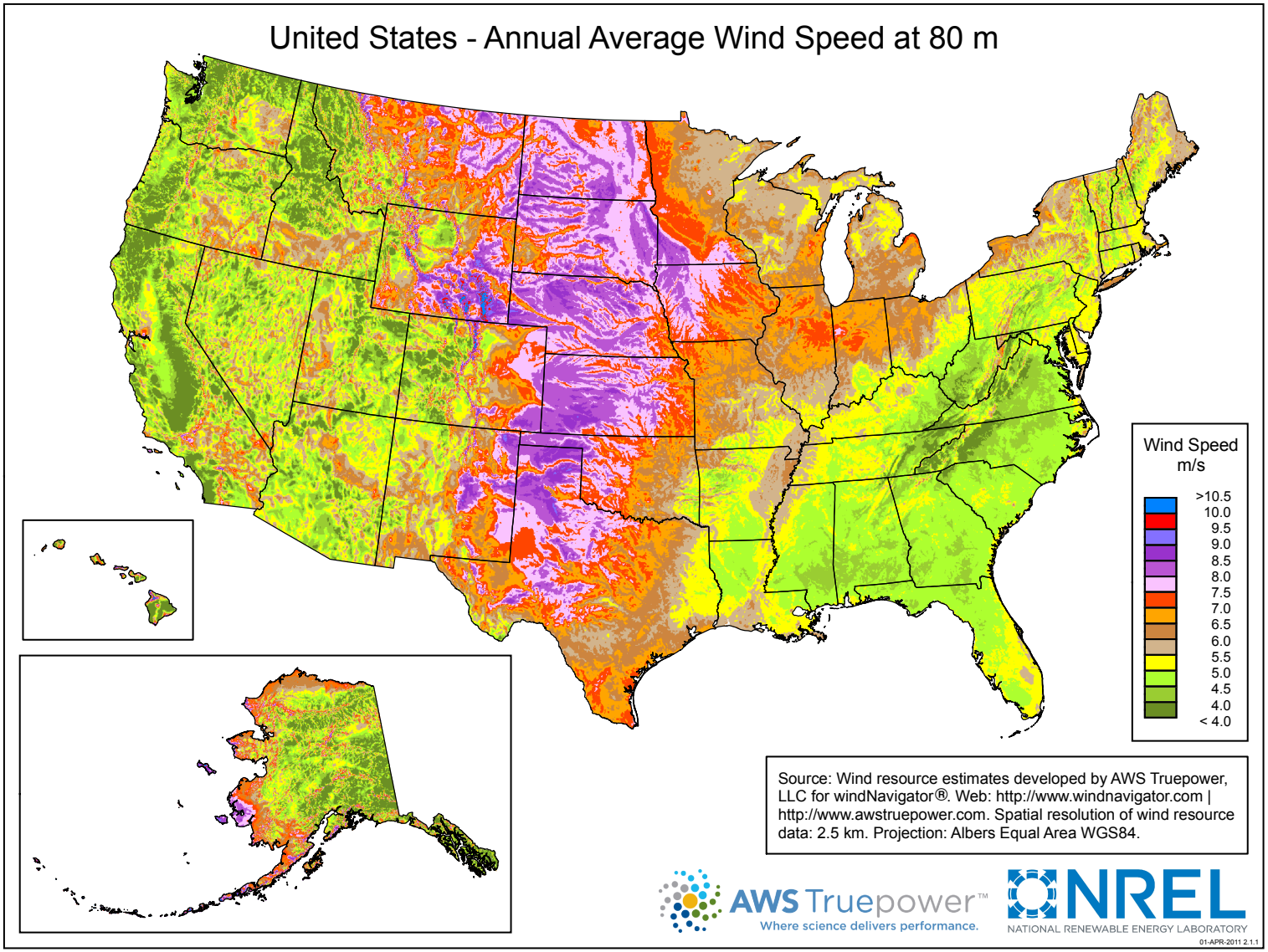
Power Up! Prelab: Reading a Wind Map



Teacher's Notes – Power Up! Prelab

Reading a Wind Map

Overview

Scientists often deal with massive amounts of data and need to show it in a concise way. This is done with charts, graphs, and pictures. At its core, a map is a set of data. Each pixel in an image can be though of as a unique data point describing a condition at that point. Being able to interpret a visual representation of data is an important skill for students to develop, as it requires multiple levels of increasingly complex thinking.

Content Discussion

Wind speed can vary widely depending on local geography, man-made structures such as buildings, weather patterns, and elevation. This map shows average wind speeds at 80 meters above the ground. Wind is much more consistent at this height, compared to ground level. Therefore, land-based, utility-scale wind turbines are generally installed between 80 and 100 meters above the ground. Construction of wind farms requires a detailed planning process that considers many factors such as access to the electric grid, environmental impact, proximity to airports, and numerous others. However, the single most important factor is simple, amount of wind.

Common Preconceptions

A map is a representation. Younger children (K-2) often have difficulty understanding that the features of a representation do not actually exist in the real world. For example, these children may think, according to this map, the ground in Kansas is purple. Maps are abstract representations. A learner's ability to think abstractly develops over time, but as increasingly abstract representations are presented such as the Cartesian coordinate system in algebra, they begin to struggle with this skill and need proper support in the process.

Concepts/Skills

- Wind energy
- Visual literacy
- Representations

Learning Objectives

- Explain how data can be communicated through an image
- Articulate a visual representation into concise statements
- Infer how geographic features affect average wind speeds

Materials

- Wind map
- Shaded relief map (optional)
- Photos of regional geography (optional)

Instructional Sequence

Accessing Prior Knowledge

Before showing the map, ask some probing questions. The best questions draw out the students' unique experiences and perspectives. Here are some examples:

> ***"What kinds of places are windy? Not windy?"***
>
> ***"What is the windiest state?"***
>
> ***"What major city is known as the 'Windy City'? Is it?"***

Present the map to the students. If you are using a computer projector or interactive whiteboard, consider providing a copy to each student or group. In order to gain insight into your students' thinking, ask some very open questions about what the map is showing:

> ***"What do you see?"***
>
> ***"What do the different colors mean?"***

Encourage a variety of responses. The goal is not to obtain correct statements but to assess their background knowledge. This information is crucial to guiding instruction through the remainder of the activity.

Best Practices in Teaching

The beginning of a lesson is a crucial time for teachers and students. It should prompt the learner to use his or her own prior knowledge while also making this knowledge visible to the teacher. Having the students make claims or predictions is often an effective approach. This increases student engagement for the rest of the lesson because the student has a natural desire to confirm his or her prediction. Consequentially, if their experiences during the lesson challenge this prior knowledge, authentic learning takes place.

Take nothing for granted when it comes to learners. Some students may have trouble discerning the colors on the map and key. Also, students often overlook key information such as the title of the map.

Developing Understanding

Use the wind map as a discussion piece for your students. Gradually scaffold the discussion to develop their ability to make inferences about what is not explicitly stated in the map.

> ***"What parts of the country tend to be the windiest?"***
>
> ***"Are you surprised by anything that you see? Why?"***

Cooperative Learning Opportunity

Divide the class into small groups and pose the following question:

> ***"Which state has the most wind?"***

Allow the groups several minutes to discuss and debate this question. You can also limit the choices to a couple of states (California or Illinois, for example) in order to narrow the discussion. Afterwards, allow each group to present their choice to the class. A "round-robin" format is often useful. It allows each group to present their opinion before any judgments are made. Different viewpoints can then be used to foster discussion and debate. Some students

Questioning Techniques

Allow for silence if you ask a difficult question. Resist the temptation to immediately offer up hints.

"Wrong" answers almost always have elements of truth or interest. These cannot only be used to move the discussion along, but also make the students more comfortable sharing their ideas, knowing they won't be flat-out rejected.

The most effective questions do not have a definite answer. Open-ended questions encourage critical thinking and spark discussion between students.

will consider the size of the state, others will simply look at the overall colors present.

In order to spur discussion, inject some information that may seemingly contradict what is shown on the map. For example, California generated almost twice as much electricity (6,022 MW) as Illinois (3,842 MW) in 2015.

The data in a representation is usually rooted in a number of variables that are not explicitly stated. In the case of the wind map, there must be some factors that cause some parts of the country to be windier than others.

> ***"Why are some parts of the country windier than others?"***

It may be helpful to show the students pictures from different parts of the country. A shaded relief map could also be helpful. Students will generally conclude that flat areas like the Great Plains are windier. However, point out that Florida is actually the flattest state, but has very little wind. This will spur discussion about what other factors (weather patterns, nearby geography such as mountains and oceans) are at work.

Learning Beyond the Classroom

Conclude the discussion by posing a simple question:

> ***"If you were to build a wind farm to deliver electricity a major city (choose one near your school), where do you think would be a good location?"***

Students will likely have many immediate ideas, but the purpose here is not to answer this question, but to stimulate thinking after the lesson is done. The question that is being established here is whether wind speeds are the only consideration when determining the location of a wind farm.

While at Argonne…

Unfortunately, the best winds in the United States (the Great Plains) are not close to most population centers. After this map reading activity, many students will believe that these states are an ideal location for wind farms. However, sending electricity over great distances comes at a cost. For every 100 miles of power lines, 6% of the electricity is lost due to resistance. At Argonne, students will see how scientists are attempting to solve this problem.

Understanding the principles of energy production, its distribution, and use in homes and industry are vital to solving the complex problem of making renewable energy a widespread reality. When the students visit Argonne, they will see that this problem requires creativity and a multilayered approach. For example, geography, transmission distance, and population density are important factors to consider. Their experiences in the Learning Labs will allow the students to have a broader perspective and be able to weigh the various factors that determine the viability of wind energy as a primary electricity source.

Facilitating Debate

Facilitate this discussion by highlighting differences of opinion and having groups support their claims with evidence and reasoning.

Discrepant Events

One of the most valuable ways to engage learners and developing critical thinking skills is to provide an unexpected experience or fact known as a "discrepant event". These situations cause a "cognitive disequilibrium" that forces the learner to reconcile the unexpected observation with their prior knowledge. This is intrinsically motivating and drives learning.

To Homework or Not To Homework?

Homework can take many forms. You may ask the students to write a response to this question or to simply think about it. Either way, the value of homework is not in its format, but what it asks the student to do and how the teacher follows through in subsequent interactions.

Technology Integration

The wind map is available at:

http://apps2.eere.energy.gov/wind/windexchange/wind_maps.asp

Therefore, students can be given paper copies to examine, but if they have access to computers or tablets, they can view the map in higher resolution. Also, individual states can be clicked on to examine wind speeds on a much more local level. This allows students to examine how variables such as geography and population centers affect wind speed.

References

- Map skills and higher order thinking: http://www.learnnc.org/lp/editions/mapping/6439
- US Department of Energy WINDExchange: http://apps2.eere.energy.gov/wind/windexchange/